CLAIMS

What is claimed is:

1. A method of determining production rates in a well, comprising:

determining a model of temperature as a function of zonal flow rates in the well;

measuring temperatures at a plurality of locations in the well; and

inverting the measured temperatures by applying the model to determine an allocation of production rates from different producing zones in the well.

2. The method as recited in claim 1, wherein determining comprises determining the model for a single-phase liquid producing well.

3. The method as recited in claim 1, wherein determining comprises determining the model for a multi-layer producing well.

4. The method recited in claim 1, wherein determining comprises determining the model for a multi-layer, single-phase liquid producing well.

5. The method as recited in claim 1, wherein determining comprises determining the model for a multi-layer, multi-phase liquid producing well.

6. The method as recited in claim 1, wherein measuring comprises measuring temperature with a distributed temperature sensor.

7. The method as recited in claim 1, wherein inverting comprises determining a degree of certainty in the production rates allocated.

8. The method as recited in claim 7, wherein determining the degree of certainty comprises determining a degree of error in the model.

9. The method as recited in claim 7, wherein determining the degree of certainty comprises determining a degree of error in the measured temperatures.

10. The method as recited in claim 7, wherein determining the degree of certainty comprises determining a degree of error in well parameter values.

11. The method as recited in claim 1, wherein inverting comprises utilizing a generalized reduced gradient optimization algorithm.

12. A method of determining flow rates in a well, comprising:

measuring temperature at a plurality of points along the well having a plurality of well zones and a plurality of liquid phases; and

determining flow rates of the plurality of liquid phases through each of the plurality of well zones via the measured temperatures.

13. The method as recited in claim 12, wherein measuring comprises utilizing a distributed temperature sensor.

14. The method as recited in claim 12, wherein determining comprises constructing a model of temperature as a function of zonal flow rates in the well, and using the model to invert the measured temperatures in allocating flow rates from the plurality of well zones.

15. The method as recited in claim 12, wherein determining comprises determining flow rates of oil and water phases during production.

16. The method as recited in claim 12, wherein determining comprises determining flow rates of fluid injected into each of the plurality of well zones.

17. The method as recited in claim 14, wherein inverting the temperatures comprises utilizing an optimization algorithm.

18. The method as recited in claim 12, wherein determining comprises measuring a total flow rate at a wellhead.

19. A system, comprising:

a temperature sensor deployable with a production completion along a wellbore to sense temperature data at a plurality of wellbore locations during production; and

a processor system able to receive the temperature data and allocate a flow rate from a plurality of wellbore zones based on the temperature data.

20. The system as recited in claim 19, wherein the processor system uses a temperature forward model, in which temperature is a function of zonal flow rates, to invert the temperature data and allocate flow rates from producing layers of a formation.

21. The system as recited in claim 19, wherein the temperature sensor comprises a distributed temperature sensor.

22. The system as recited in claim 19, wherein the processor system is able to allocate flow rates in a multi-layer, multi-phase liquid producing well.

23. The system as recited in claim 19, wherein the production completion comprises an electric submersible pumping system.

24. The system as recited in claim 19, wherein the production completion comprises a gas lift system.

25. The system as recited in claim 19, wherein the wellbore is oriented generally vertically.

26. A method, comprising:

deploying a distributed temperature sensor along a wellbore;

utilizing a model of temperature as a function of fluid flow rates into the wellbore;

obtaining temperature data from the distributed temperature system;

allocating a fluid flow rate in at least one wellbore zone using the temperature data in conjunction with the model; and

determining error in the fluid flow rate.

27. The method as recited in claim 26, wherein allocating comprises inverting the temperature data to obtain the fluid flow rate.

28. The method as recited in claim 26, wherein deploying comprises deploying the distributed temperature system in a generally vertical wellbore.

29. The method as recited in claim 26, wherein deploying comprises deploying the distributed temperature system in a deviated wellbore.

30. The method as recited in claim 26, wherein allocating comprises determining fluid flow rates across a plurality of wellbore zones.

31. The method as recited in claim 26, wherein allocating comprises determining flow rates for a single-phase liquid producing well.

32. The method as recited in claim 26, wherein allocating comprises determining flow rates for a multi-phase liquid producing well.

33. The method as recited in claim 26, wherein determining comprises compensating for model error, measurement error, and well parameter error.

34. A system, comprising:

means for measuring temperature at a plurality of points along a well having a plurality of well zones and a plurality of liquid phases; and

means for determining flow rates of the plurality of liquid phases through each of the plurality of well zones via the measured temperatures.

35. The system as recited in claim 34, wherein the means for measuring comprises a distributed temperature sensor.

36. The system as recited in claim 34, wherein the means for determining comprises a processor system able to receive the temperature data and allocate a flow rate from a plurality of wellbore zones based on the temperature data.